User manual
VIDITECH 2000RV
VIDITECH 2000RV/E

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protection class II. device

warning, see safety instructions in manual

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1 INTRODUCTION

Viditech 2000RV is a six-channel digital instrument for measuring and evaluating shaft vibration and temperature of rotating machines.

1.1 Basic advantages of the instrument

FFT analysis – detail analysis containing ca. 2 200 spectral lines

High pass – from 2 Hz

Low pass – options (250 Hz, 1000 Hz, 4000 Hz)

New firmware – easy update performed by customer

ModBus communication – update and SW support of remote access

1.2 Number of measuring channels

- 2x relative shaft vibrations – options for Max (X, Y), or Smax
- 4x temperature (3-conductor PT 100)

Each channel contains a limit L1 (warning) and L2 (danger).

For vibration measuring accelerometers with ICP supply are used.

1.3 Current outputs and relays

The instrument communicates with the superior system through 6 current outputs (4-20) *mA*.

- 2x vibration (X, Y)
- 4x temperature (A, B, C, D)

These relays ensure complete protection of the diagnosed machine.

- OK relay (ensuring a trouble-free state of the instrument)
- L1 relay (user defined warning of a raised value)
- L2 relay (user defined warning of a high value)

Vibration channels (X, Y) have their own buffered outputs on the BNC connectors.

1.4 Communication interface

- ModBus RTU (version 2000RV) / ModBus over Ethernet (2000RV/E)

The communication interface ensures connection to the Ethernet, through which it is possible to monitor and control the instrument. It is possible to choose between ModBus RTU (through RS485) and ModBus over Ethernet (connectable using standard RJ-45 connector).

1.5 Software support enables

- Orbit creation.
- Displaying signal development in time.
- Saving and creating history of records.
- Complete instrument operation.

1.5 Instrument attachment dispositions

- Small size – it is also possible to place the instrument into a separate (industry) box
- Mounting – easy assembly using a DIN moulding.

2 OUTER DESCRIPTION OF THE INSTRUMENT

2.1 Keyboard

The keyboard is functionally divided into 3 main areas (display, control buttons and signalling of instrument state), see fig 1. In the central part a visor for a four-line display is placed. Under the display the control panel in form of four buttons is situated. Arrow buttons *up* ▲ and *down* ▼ serve to browse the menu of the instrument, required options are confirmed by the button *enter* ✓ and cancelled by the button *cancel* ✕. Above the display LED-diodes (OK, L1, L2) are placed, reflecting the current state of the measuring unit and the diagnosed object. The name of the instrument with its serial number is stated in the heading.

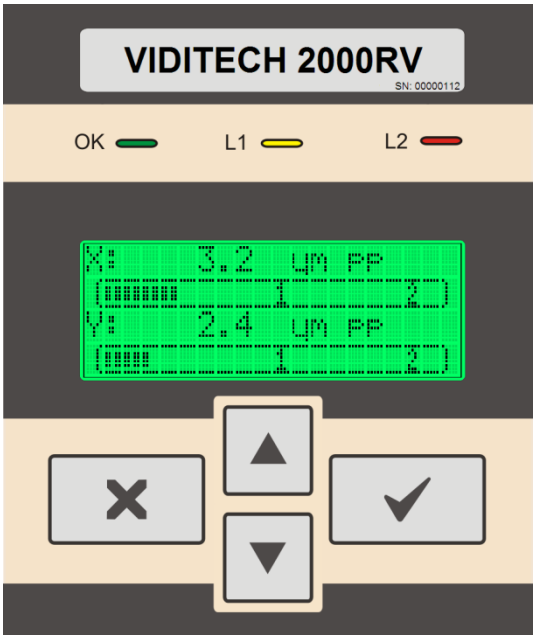


Fig. 1 Front view of the instrument control panel.

2.2 Terminal board

Terminal boards in the bottom and top part of the instrument are used to connect inputs and outputs. This access enables standard attachment of more devices in close proximity and is very user friendly.

Terminal board in the bottom part contains input for power supply +24 V, outputs for relay OK, L1 and L2, reset of relay L2 and a communication interface ModBus.

Fig. 2 Description of the bottom terminal board

Terminal board in the top part of the instrument contains inputs for:

position sensors (channels X, Y)

temperature sensors PT100 (channels A, B, C, D)

logical inputs TM (Trip multiply), TRG (Trigger) and SPD (speed)

Terminal boards also contain current outputs (4 – 20) mA for position reading (X, Y) and temperature *T* (A, B, C, D).

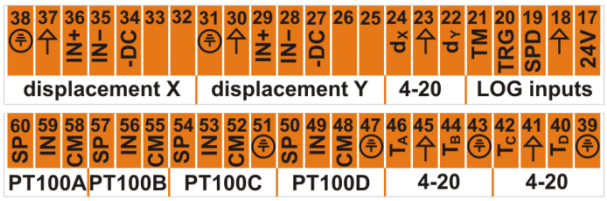


Fig. 3 Description of the top terminal board.

2.3 Attachment of the instrument

The back side of the instrument is equipped with a standard DIN moulding (comfortable assembly). It is possible to place the instruments close to each other (holes for air cooling are placed in vertical direction).

2.4 Box

Fully occupied instrument including a holder for the DIN moulding and fully connected terminal boards has maximal dimensions (height/width/depth) 137/90/108 mm (see fig. 4). The primary box is made of steel with a surface treat against corrosion and is surface varnished. The back side of the box is made of anodized aluminium plate (for heat dissipation). Used material is selected with regard to high endurance against electromagnetic disturbance.

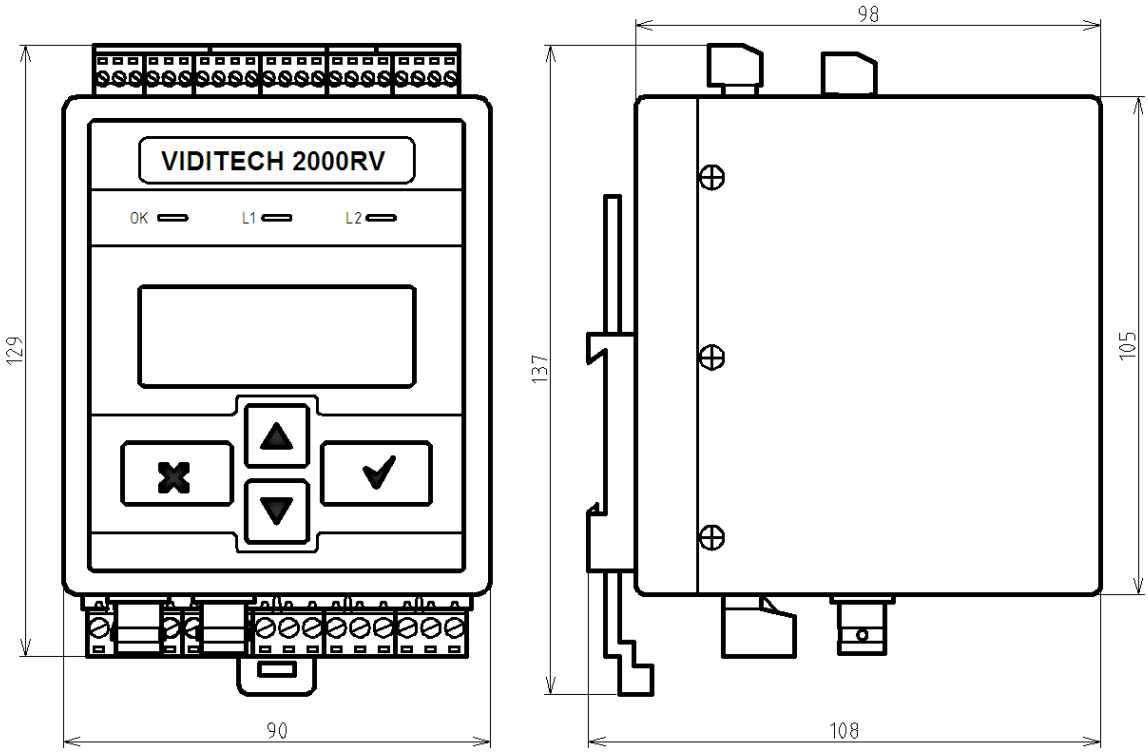


Fig. 4 Mechanical dimensions of the instrument.

3 INITIATION OF THE INSTRUMENT TO OPERATIONAL STATE

3.1 Initialization

After turning on the power supply the instrument automatically initializes, which consists of stabilization of filters and initiation of the internal test (Selftest).

3.2 Main screen

Main screen displays a preview of the current relative shaft vibration values (X, Y), see fig. 5. These values are stated numerically. A bar graph is used to display ranges, also includes set limits (L1 – warning, L2 – danger). Next to the bar graph a percentage range to limit L2 is displayed. In case of unconnected vibration input, "sensor error" is displayed at the respective channel. The same warning notification is displayed, if the connected sensor is damaged. Main screen also includes two temperatures (A, B). If no temperature sensors (PT 100) are connected to these channels, N/A is displayed.

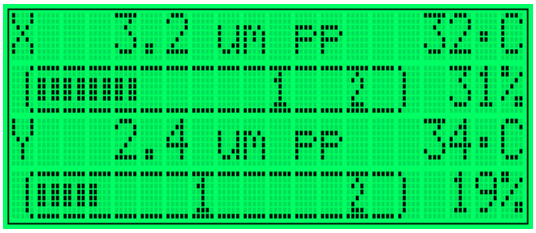


Fig. 5 Main screen of the instrument after initialization into operating condition.

3.3 Instrument restart

Restart of the instrument is possible by simultaneously pressing buttons ▲ and ✔ for at least *2 s*. Afterwards the following are displayed: name of the instrument and instrument FW version, hardware and FW of the middle board. After these system data are presented, the filters are stabilizing and the *Main screen* is displayed (fig. 6).

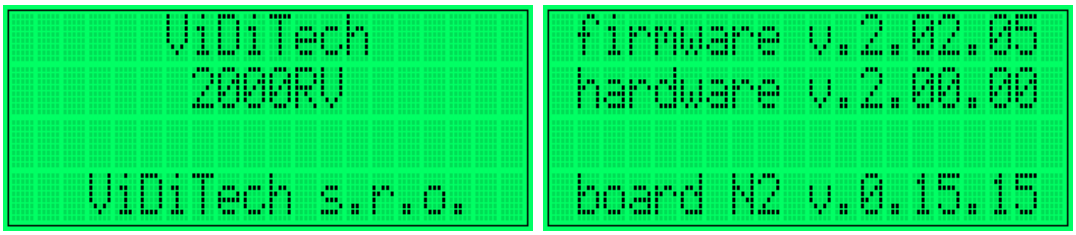


Fig. 6 Preview of the screen during restart.

4 STARTING MENU

Arrow buttons ▲▼ are used to browse the starting menu, which contains 3 screens in total (main screen, exceeded limits, temperatures and information about the diagnosed machine), see fig. 7.

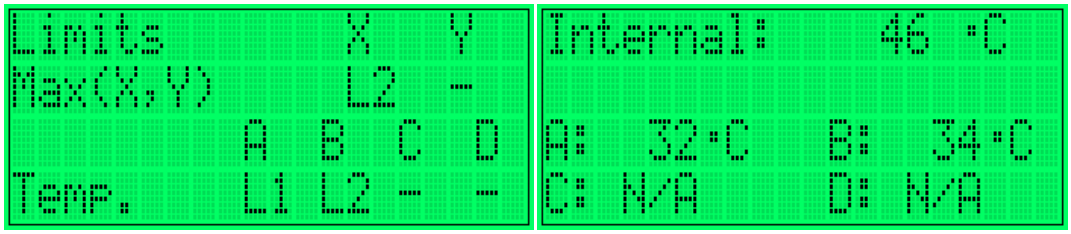


Fig. 7 Starting menu of the instrument (limits, temperatures).

4.1 Limits

By using the arrow button ▼, information about whether the set limits L1 or L2 of the measured parameters have been exceeded for all channels of the instrument (fig. 7). Among measured parameters belong the velocity of vibrations, conditions of the bearing and temperature (temperature is possible to measure by up to 4 channels). If any measured parameter exceeds the set limit, instead of the *dash* – an exceeded limit **(L1, L2)** is displayed.

4.1 Temperatures

By pressing ▼ again, temperatures in all channels (A, B, C, D) are displayed. *N/A* is displayed if any channel has no temperature sensor connected. On the first line of the menu the internal temperature of the instrument is displayed, see fig. 7.

5 NESTED MENU

The nested menu can be triggered by the ✔ button and left by the ✖ button. This menu includes the following options (Analysis, Trends, Postmortem data, Sensor install a Setup), see fig. 8:

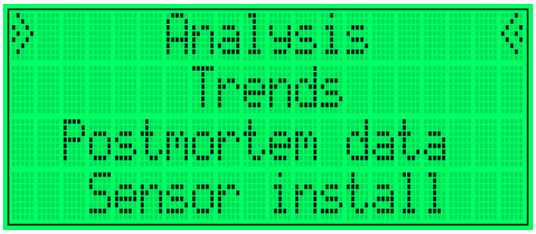


Fig. 8 Preview of the nested menu options.

5.1 Analysis

5.1.1 Velocity of vibration analysis

Using this option an analysis of the relative shaft vibration in the frequency domain 2 Hz – 4 kHz can be obtained. Fast Fourier Transform (FFT) containing ca. 2 200 frequency lines is used for the calculation. After the analysis 20 highest lines ranged by maximal amplitude are displayed. For analysis of each channel the following are available:

window function – rectangular / Hann

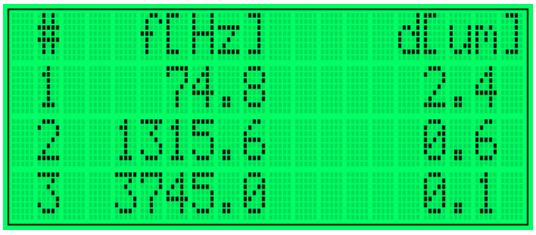


Fig. 9 Sample list of frequency lines.

5.2 Trends

Trends include long term records of measured parameters (Max (X, Y), Smax and temperature), divided into three time intervals, see fig. 10. Only the parameter of shift (Max (X, Y) or Smax), that is selected in the instrument setup, is saved into the trends.

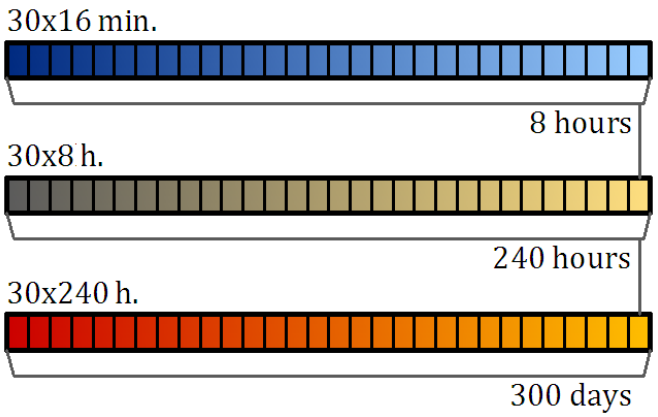


Fig. 10 Scheme of trend creation.

5.2.1 First time interval

The basic time interval, which is averaged for trend calculation, is *16 minutes*. This enumeration is displayed graphically in the form of 30 lines of basic time intervals. On the display the time interval is shown in two steps (*0 min – 224 min*) and after pressing ▼ (*240 min – 464 min*). During enumeration of the trend there is a change on the display in the bottom line between time range and maximal/minimum value of the given record, see fig. 11.

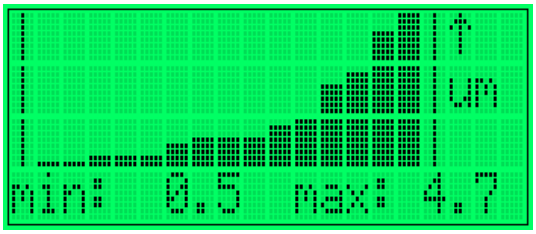


Fig. 11 Preview of the relative vibration trend of the first interval.

5.2.2 Second time interval

The second time interval is displayed after another press of the ▼ button. The display is analogous to the previous case. Every line of this interval is calculated as a sum from the first interval. The total range is again divided into two screens (*0 hour – 112 hours* and *120 hours – 232 hours*).

5.2.3 Third time interval

The third time interval is solved as the previous. Every line is calculated as a sum of the previous interval. The total range is again divided into two screens (*0 days – 140 days* and *150 days – 290 days*).

5.3 Postmortem data

This type of saved data is formed as a circular recorder with a length over 17 minutes. In the moment of exceeding the L2 limit (when the machine is turned off) the recording continues for another 29 s, see fig. 12. Besides information about exceeding limits, the Postmort recorder is an important tool when searching for links about the machine drop-out.

!!! After turning off or restarting the instrument, the Postmort record is deleted !!!

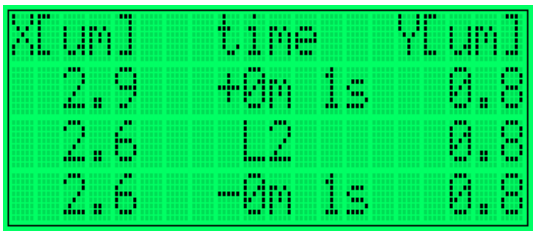


Fig. 12 Postmort recorder preview.

5.4 Sensor installation

The sensor setup is performed according to transfer characteristic of distance to output voltage, in the centre of the linear band of the sensor. Values of voltage for both channels (X, Y) and actual revolutions (with the connected revolution sensor) are displayed on the screen.

Operating output voltage should be in the range 6,5 V – 16 V. If decrease or increase out of this operational range occurs, the OK relay on the instrument will shut down. The value during sensor setup should be 12 V, see fig. 13.

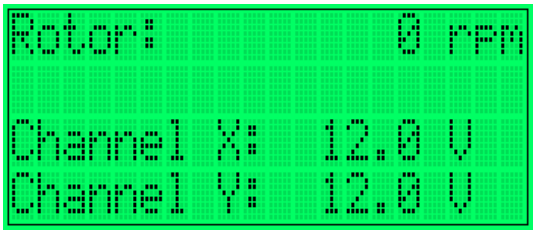


Fig. 13 Setup of the connected sensors.

5.5 Setup

The instrument setup enables setting the instrument parameters, channels and limits. The individual items in this menu are protected by a password. The instrument password is set to 77320 by default.

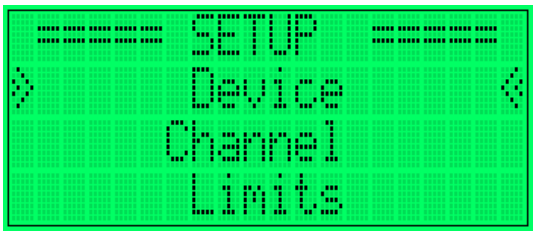


Fig. 14 Instrument setup – communication parameters.

5.5.1 Device

The password (77320) is requested after entering this item. The password is inserted by ▲▼ and confirmed by the ✔ button. The first displayed screen obtains items regarding the instrument communication, see fig. 15. For a change request of the default parameter press ✔ on the required line, then input the change and confirm by pressing ✔ or cancel the selection by pressing ✖.

First menu screen of the instrument setup

instrument ID (1 – 63)

The identification number serves for explicit instrument designation within the ModBus bus line.

transfer speed (4,8; 9,6; 19,2; 38,4; 57,6; 115,2) kBps

Default value is 57,6 kBps.

parity (even/odd/none)

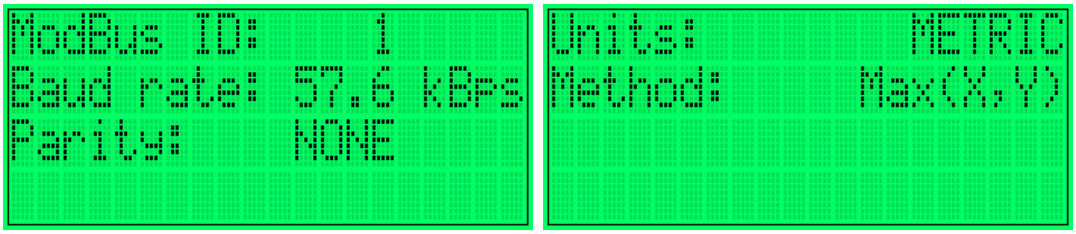


Fig. 15 Instrument setup – communication parameters.

The next menu screen of the instrument setup offers the following selection

Unit type: Metric / Imperial

Measuring method: Max (X, Y) / Smax

The instrument enables selection of method for evaluating measured parameters from two options: Smax, or Max (X, Y). The principle of evaluation is graphically shown in fig. 16. Smax method uses the absolute maximal deviation and is more applied in Europe. Max (X, Y) method evaluates peaks only in read axes and is more used in the USA.

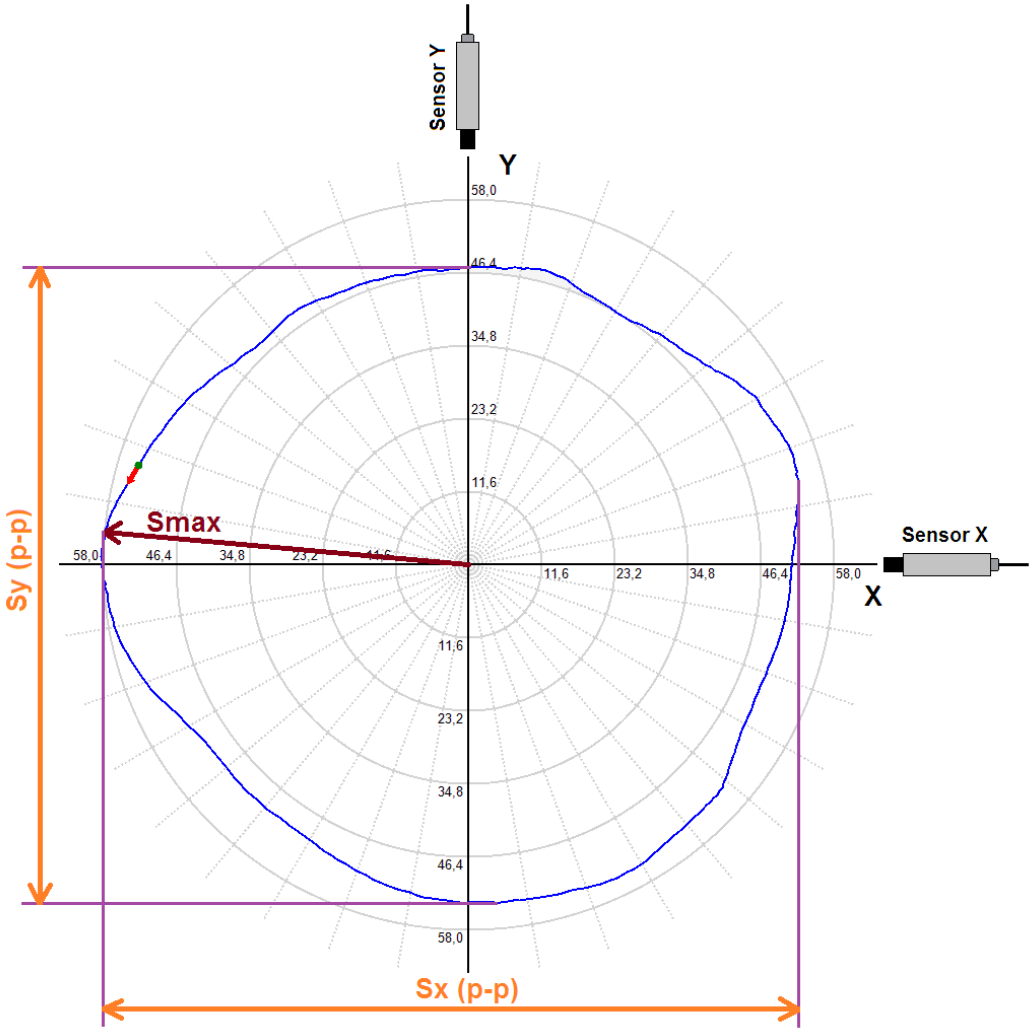


Fig. 16 Methods of evaluating measured parameters.

Logical input selection NPN / PNP (fig. 20):

Reset of inputs – Reset input

Revolution input – RPM input

Trip Multiply – Trip input

Log3 (not used) – unoccupied position

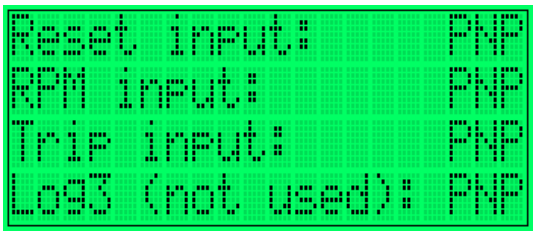


Fig. 20 Instrument setup – selection of logical input.

Selection of revolution and sensor orientation

Shaft direction :

CW: rotation of the shaft clockwise

CCW: rotation counter clockwise

Shaft speed: (0 – 15000) rpm

It is possible to use this option in case no revolution sensor is connected.

Sensor orient.: 0° x 45°

Orientation of sensors in vertical/horizontal position, or in **V** shape (45° rotation)

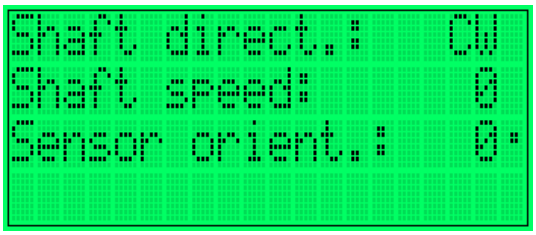


Fig. 20 Instrument setup – logical inputs selection.

Among the last instrument setup belong

Contrast of display: 0 – 100 %

Reset of time during instrument running: YES/NO

Password change: YES/NO

Password to enter *Machine setup* can be defined by the instrument operator. Nevertheless the default password noted in the manual is always functional (protection from operator mistake).

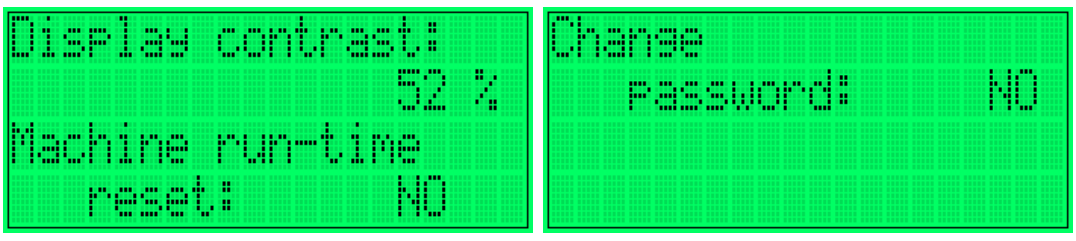


Fig. 19 Instrument setup – other options.

5.5.2 Channel

After entering this setup it is possible to input the sensitivity of accelerometers connected to channels X, Y. Advancing to other screens using ▼, these options for both channels are displayed:

Sensitivity: OFF /(0.01 – 99.99) mV/µm

High pass: OFF / 2 Hz

Low pass: (250, 1000, 4000) Hz

Range: (10, 20, 50, 100 a 200) µm

Machine on threshold: (1 – 50) % of the range

Trip multiply: (1.0 –20.0) x L2

Used during instrument start up to bridge the critical revolution. If TM is active (relevant logical level at input), limit L1 is functionless and limit L2 is multiplied by parameter TM.

Reset of trends: YES/NO

!!! WARNING !!! Reset of trends starts for all channels at once.

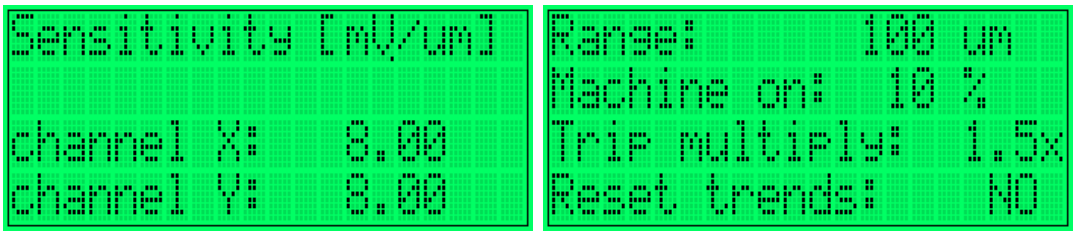


Fig. 20 Instrument channel setup preview.

5.5.3 Limit

Limits are set for all measured parameters simultaneously. It is necessary to reuse the password (77320) for their initiation.

After stepping into the limit setup it is possible to enter bounds for limit 1 and limit 2 (from 1 µm/s up to the set maximal range). The next parameter is time, for which the limit must be exceeded, to be triggered (range *1 s – 10 s*).

It is possible to set temperature limits for all channels (A,B, C, D). The limit can be allowed by entering the respective value, or turned off (OFF). In case of unconnected temperature sensor, N/A is displayed at the channel, and it is not possible to set limits.

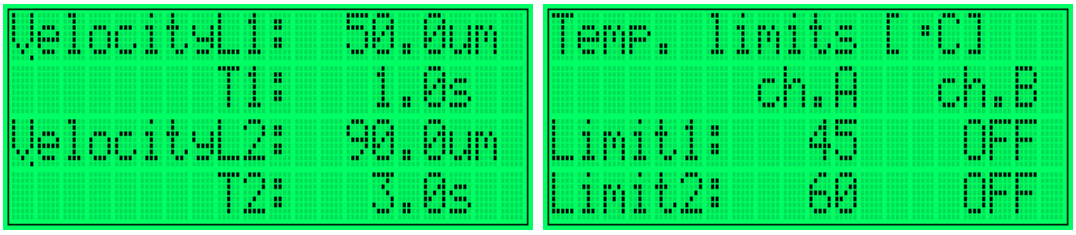
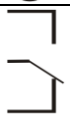
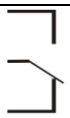
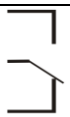


Fig. 21 Setup – Limits.

6 TERMINAL DESCRIPTION

Nr	Labelling	Description
1	24V	Instrument power supply terminal – positive pole
2	GND	Instrument power supply terminal – negative pole
3	⏚	Grounding terminal
4		OK relay
5		
6		
7		L1 relay
8		
9		
10		L2 relay
11		
12		
13	⏚	Ground potential (GND) – galvanically separated from GND on terminal 2
14	L2	Input reset relay and limit L2
15	B	Bus ModBus – pole B
16	A	Bus ModBus – pole A
17	24V	Power supply voltage for logical sensors for LOG inputs (galvanically separated from 24 V on terminal 1)
18	⏚	Ground potential (GND) – galvanically separated from GND on terminal 2
19	SPD	Input for revolution sensor (signal)
20	TRG	Input for synchronizing input (signal)
21	TM	Input for sensor (signal) activating Trip Multiply
22	d_Y	DC output (4-20) mA –channel Y, displacement
23	⏚	Ground potential (GND) – galvanically separated from GND on terminal 2
24	d_X	DC output (4-20) mA –channel X, displacement
25		Unconnected
26		Unconnected
27	-DC	Power supply for displacement sensor Y (-24V)
28	IN-	Negative input of the displacement sensor Y signal
29	IN+	Positive input of the displacement sensor Y signal
30	⏚	Ground potential (GND) – galvanically separated from GND on terminal 2
31	⏚	Grounding terminal
32		Unconnected
33		Unconnected
34	-DC	Power supply for displacement sensor X (-24V)
35	IN-	Negative input of the displacement sensor X signal
36	IN+	Positive input of the displacement sensor X signal
37	⏚	Ground potential (GND) – galvanically separated from GND on terminal 2
38	⏚	Grounding terminal
39	⏚	Grounding terminal
40	T_D	DC output (4-20) mA – channel D, temperature Pt100
41	⏚	Ground potential (GND) – galvanically separated from GND on terminal 2
42	T_C	DC output (4-20) mA – channel C, temperature Pt100

43		Grounding terminal
44	T_B	DC output (4-20) mA – channel B, temperature Pt100
45		Ground potential (GND) – galvanically separated from GND on terminal 2
46	T_A	DC output (4-20) mA – channel A, temperature Pt100
47,51		Grounding terminal
48 52 55 58	**CM**	Negative pole of the temperature sensor PT100: PT100D PT100C PT100B PT100A
49 53 56 59	**IN**	Signal input of the temperature sensor PT100: PT100D PT100C PT100B PT100A
50 54 57 60	**SP**	Positive pole of the temperature sensor PT100 power supply: PT100D PT100C PT100B PT100A

7 MOST COMMON CAUSES OF MALFUNCTION

The instrument Viditech 2000RV has its own internal diagnostical functions, which are carried out independently on safety appliances and diagnostical activity. If the instrument discovers any errors, it informs the user using a notification on the display and turns off the OK relay. In this case the defect must be removed without delay.

Malfunction	Description	Possible cause/removal
#1 Internal error	Fault of the channel A input amplifiers	Malfunction of instrument, repair by manufacturer needed.
#2 Internal error	Fault of the channel B input amplifiers	Malfunction of instrument, repair by manufacturer needed.
#3 Channel A sensor error	DC offset of channel A out of set bounds	Disconnected sensor Defective sensor Interrupted cable of sensor Badly connected sensor
#4 Channel B sensor error	DC offset of channel B out of set bounds	Disconnected sensor Defective sensor Interrupted cable of sensor Badly connected sensor
#5	Unused	
#6	Unused	
#7 Internal error	Fault of analog part power supply	Malfunction of instrument, repair by manufacturer needed.
#8 Case overheated	Instrument overheated above 90 °C	Turn off the instrument, cool down, or secure better thermal conditions for the instrument.
#9 Internal error	Fault of the autonomous instrument memory controls (RAM and FLASH)	Malfunction of instrument, repair by manufacturer needed.
#10 Both channel sensor	DC offset of both channels (A+B) out of set bounds	Disconnected sensors Defective sensors Interrupted cables of sensors Badly connected sensors
#11 Internal FW error	Internal fault state of the instrument FW	Restart needed, or (if malfunction continues), repair by manufacturer.

8 TECHNICAL SPECIFICATION

8.1 Overall

Supply voltage	18 to 36 V DC, recommended wire area 2 mm² for 24 V terminal recommended wire area 2,5 mm² for SE terminal
Power consumption[1]	8 W ± 0,25 W
Operational temperature	0 to + 55 °C
Relays output load	5A/125 V AC 5A/ 24 V DC 5A/250 V AC
Protection	IP20
Housing material	metal, painted
Dimensions	approx. 90 x 106 x 80 (W x H x D)
Mass	approx. 700 g
Terminals	detachable terminal board, maximal wire area 2,5mm² (bottom terminals), 1,5 mm² (top terminals)
Instrument type	dual-channel
Internal impedance:	100 kΩ ± 10 %

8.2 Accuracy

• Overall	at 80 Hz: ±2 % ± 1digit within the filter range 2... 4.000 Hz: ±10 % ± 1digit at cut-off frequencies: +10 % -20 % ± 1digit
• Frequency response	40 dB/dec transition steepness 1/3/10 Hz filter 40 dB/dec transition steepness 1 kHz filter
• Temperature:	Pt100 sensor: ± 2 °C in range 10 °C to 150 °C
• Speed	10 ... 15000 RPM, ±1 % ± 5digits 1 to 20 pulses per revolution setup
• Analog outputs	±2 % of displayed value ±5 % at 2 mA output current
• FFT parameters	velocity: 7.5 kHz sampling frequency, 8192 samples acceleration: 15 kHz sampling frequency, 8192 samples
• FFT analysis of overall	Indication of frequency within the range 1 ... 1.000 Hz: ±0.9 Hz (±0.5 Hz[2]) Indication of amplitude within the selected filter range: +5 % ... -20 %
• FFT window types	Rectangular / Hann

[1] Typical power when all outputs are fully loaded
[2] Typical accuracy for single sine wave signal

- FFT averages 1/4/8/16
- Overall FFT noise +5 % + 5 digits
- Measured units mm·s^{-1} / in·s^{-1}, °C / °F

Measured ranges 10, 20, 40, 50, 100, 200 mm·s^{-1}

Frequency ranges

High freq. range: 1/3/10 ... 1.000 Hz
Low freq. range: 1 ... 100 Hz

Recommended sensor ATW08Pt

Range for OK-monitoring 6 V ± 0,4 V ... 18 V ± 0,4 V

8.3 Logical inputs DC characteristics

- Input logic low V_{ILmin} = 0,0 V
  V_{ILmax} = 1,6 V
- Input logic high V_{IHmin} = 2,5 V
  V_{IHmax} = 24,0 V
- Maximal surge current I_{smax} = 3 mA
- Max. load of +24V supply for LOGINs 60 mA

8.4 Communication

ModBus RTU

- Baud rates 4.8 / 9.6 / 19.2 / 38.4 / 76.8 / 115.2 kBps
- Parity even / odd / none

ModBus over Ethernet

- Connection 10/100Base-T Ethernet with RJ45 connector

9 ACCESSORIES

We recommend the following accessories to the 2000RV instrument:

1) Displacement sensor – e.g. IN-081 type with linear range 1,5mm. Sensor is supplied from the unit via 24 V DC power. 2000RV supports various sensitivities of sensors (typical 8 mV/µm) – up to 99,99 mV/µm.

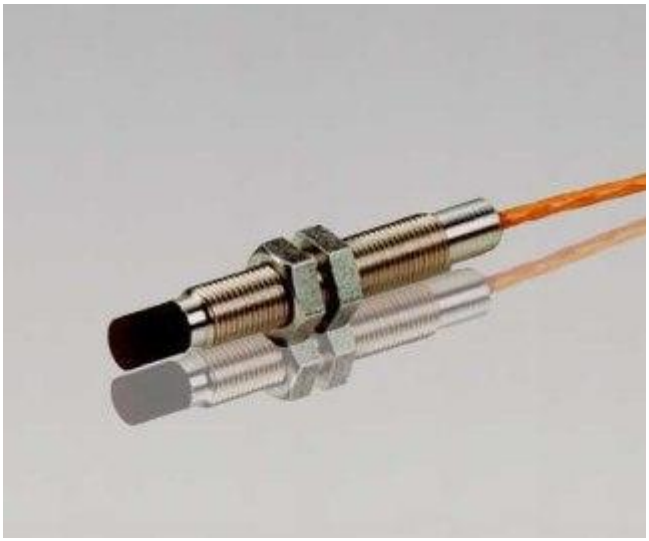


Fig. 22 Displacement sensor IN-081.

2) Converter ModBus/USB – product of ViDitech

The converter is used to connect the instrument to a PC (using a standard USB port). The converter supports all communication speeds, which are implemented in the instrument and is a simple and suitable solution to interconnect more instruments to one PC (e.g. managing instruments using Control Software).

For details visit http://www.viditech.cz/products/data-converters/usb-rs485/

Fig. 23 Converter from ViDiTech.

3) Lambda power supply

Fig. 24 Instrument power supply unit.

Power supply *230 V AC/24 V DC 10 W* is ideal for powering one instrument from the distribution network *230 V AC*. Can easily be fitted to the instrument using the DIN moulding. For powering more instruments, powerful supplies from the manufacturer´s product line can be chosen (e.g. *30 W* for 3 instruments 2000CV or *60 W* for ca. 6 units).

For details see manufacturer´s website http://www.lambda.com/

4) Control Software package – product of ViDiTech

Software working on the client – server model basis, is used for viewing, managing instruments, their control, setup, data reading and remote access to them. From measured values reports can be compiled or records saved to database.

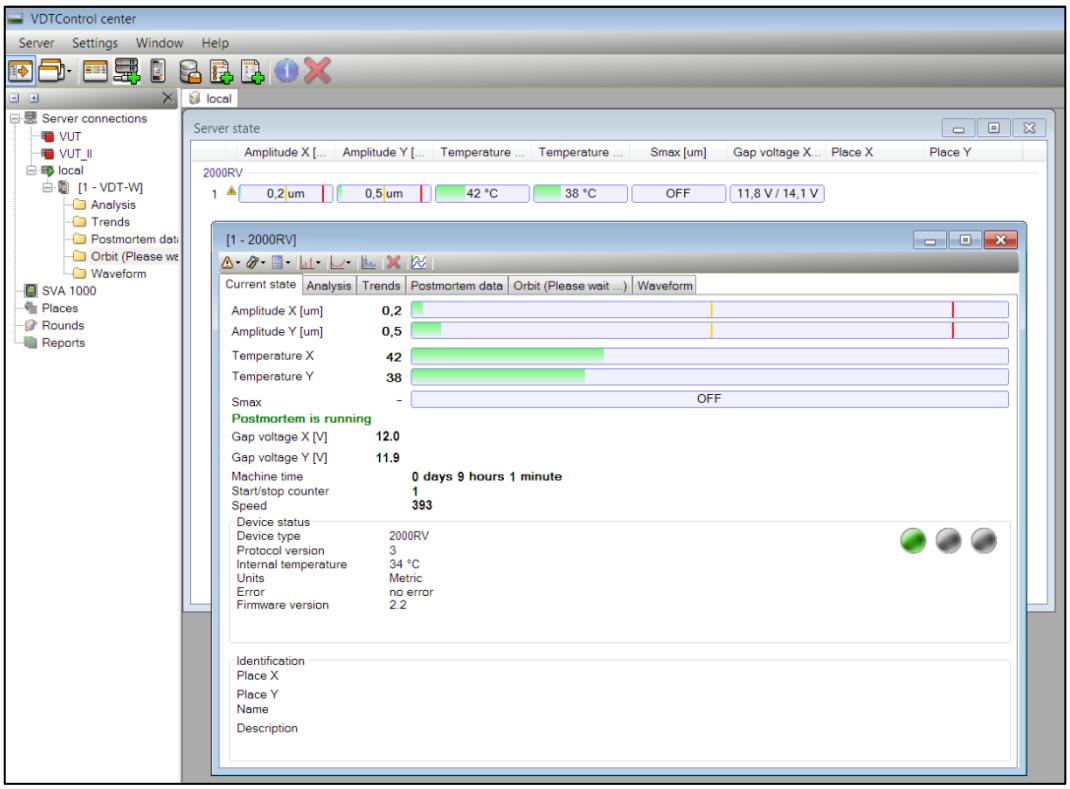


Fig. 25 Preview of SW (Control Center 2).

10 MENU STRUCTURE